

# Winter Outlook 2014-2015

Southeast Lower Michigan

December through February

Slide 2: Winter Outlook for SE Michigan

Slides 3-11: Forecast Reasoning

# Winter Outlook for Southeast Michigan

## Drier with temperatures normal to slightly colder than normal

### Temperature Trends

Cold anomalies are forecast to be greatest during the latter half of winter due to increasing northwest flow over Southeast Michigan. The strongest signal for southward displacement of the jet stream is January into February while the weakest is in December. Thus, December temperatures are the most likely to be closest to normal.

**December: Near normal**

**January: Slightly colder than normal**

**February: Normal to slightly colder than normal**

### Precipitation/Snowfall Trends

Increasing northwest flow generally favors deflection of the largest snowstorms to our east. Conditions are expected to evolve toward a drier-than-normal pattern. However, even an active clipper pattern, though dry, can result in normal snowfall amounts.

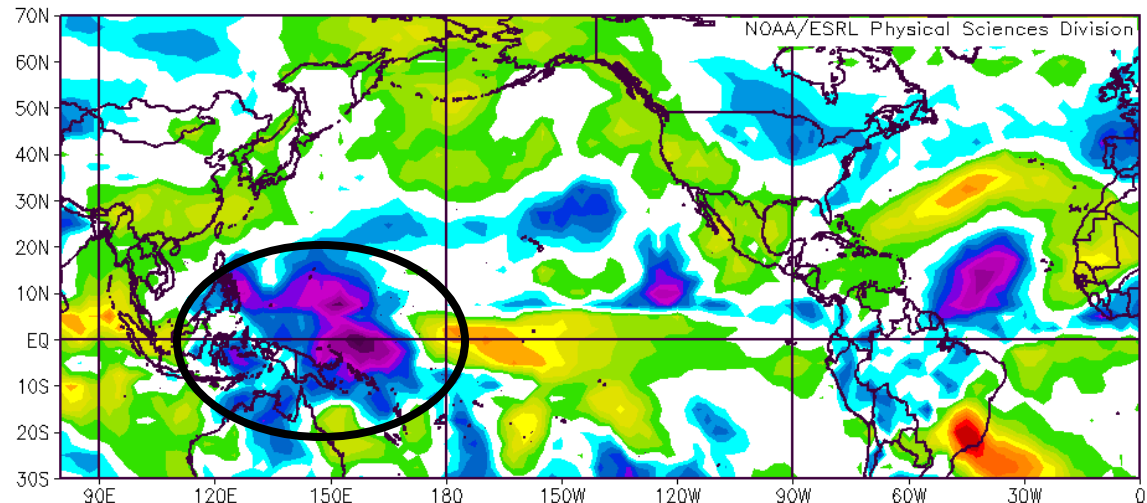
**December through February: Normal snowfall**

# A Look Back at Last Winter Tropical Thunderstorm Activity

The location of thunderstorm activity in the tropics is usually approximated by using outgoing longwave radiation as a proxy.

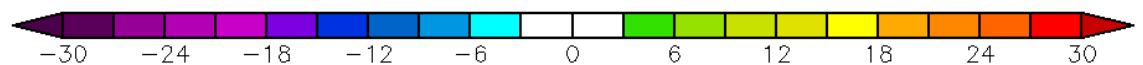
During the heart of last winter, a large, organized, and persistent region of convection was present in the western basin of the Tropical Pacific.

## Outgoing Longwave Radiation Anomaly



Surface OLR (W/m<sup>2</sup>) Composite Anomaly (1981–2010 Climatology)  
1/1/14 to 2/28/14

NOAA Uninterpolated OLR

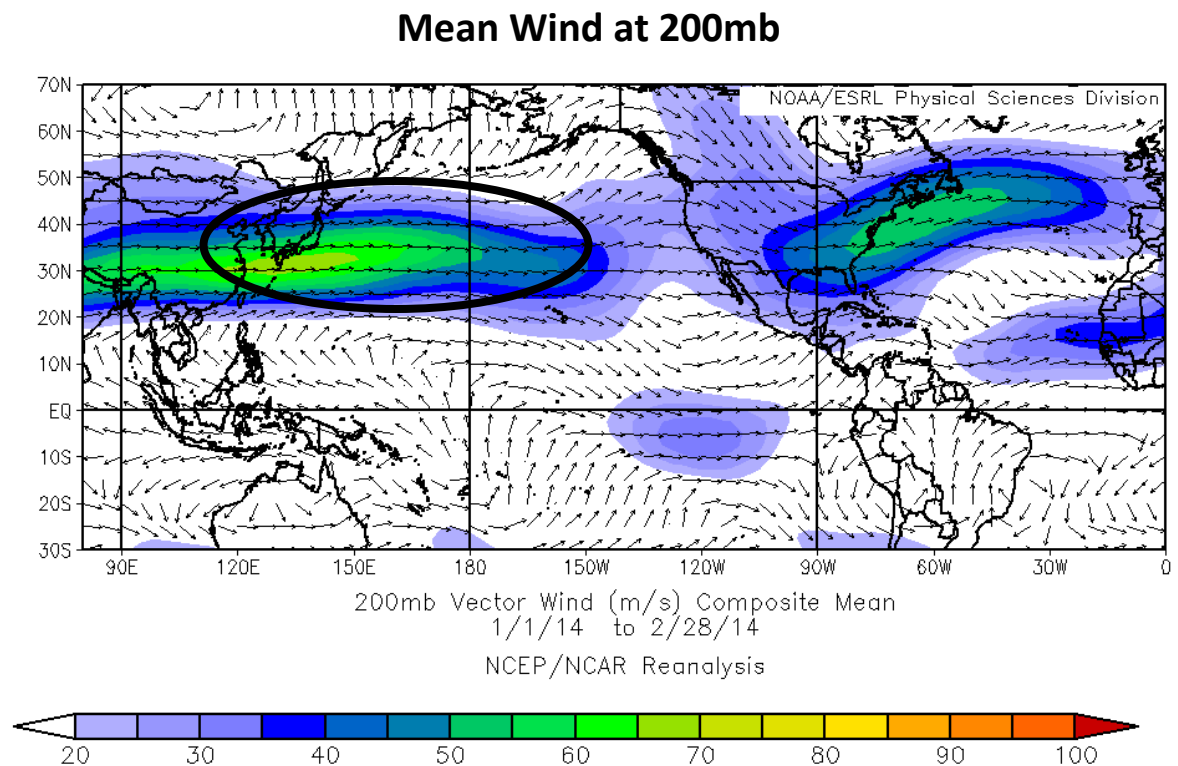


# A Look Back at Last Winter

## Jet Stream

The persistent tropical convection warmed the upper atmosphere in the surrounding region. The resulting upper-level mass gradient helped to both maintain and strengthen a strong jet over the West Pacific.

This was likely a noteworthy contributing factor to last year's severe winter (illustrated on next slide).

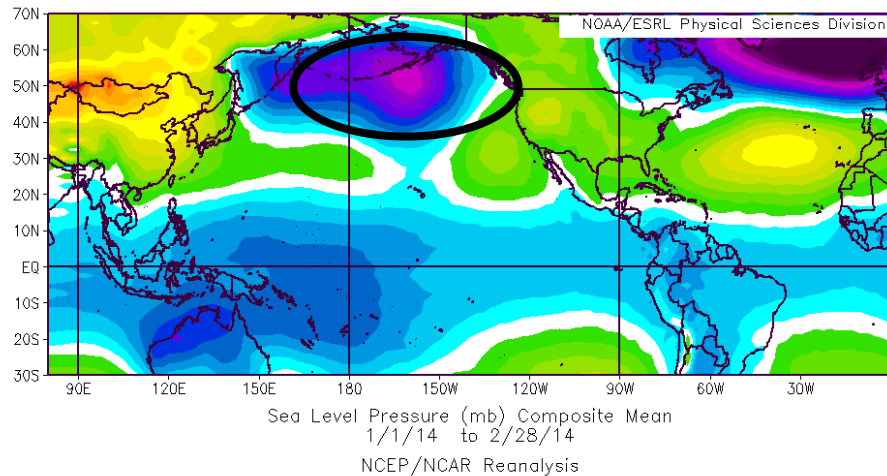


# Looking Back at Last Winter

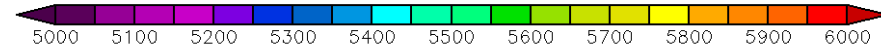
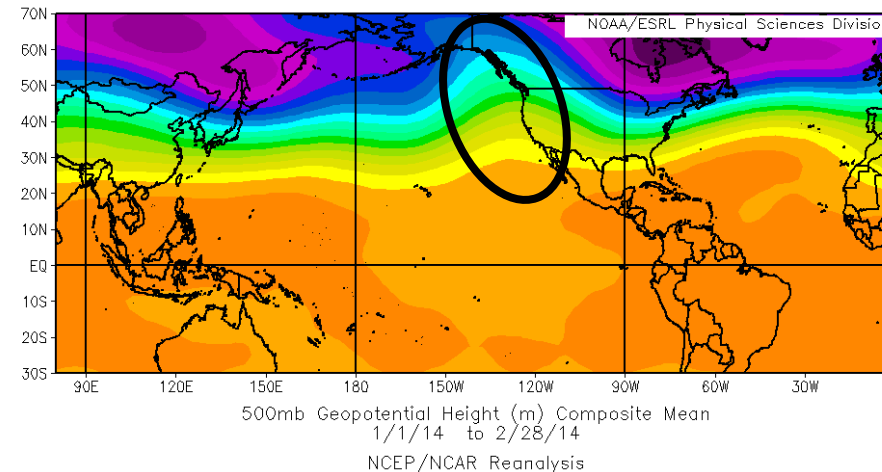
## Sea Level pressure

The persistent jet set up a favored region for cyclogenesis in the western Gulf of Alaska (circled on left). This in turn resulted in nearly continuous downstream ridge maintenance over the West Coast (circled on right). This is a good example of how weather in far reaches of the globe, especially the tropics, can impact a season thousands of miles downstream..

### Mean Sea Level Pressure



### Mean Geopotential Heights at 500mb



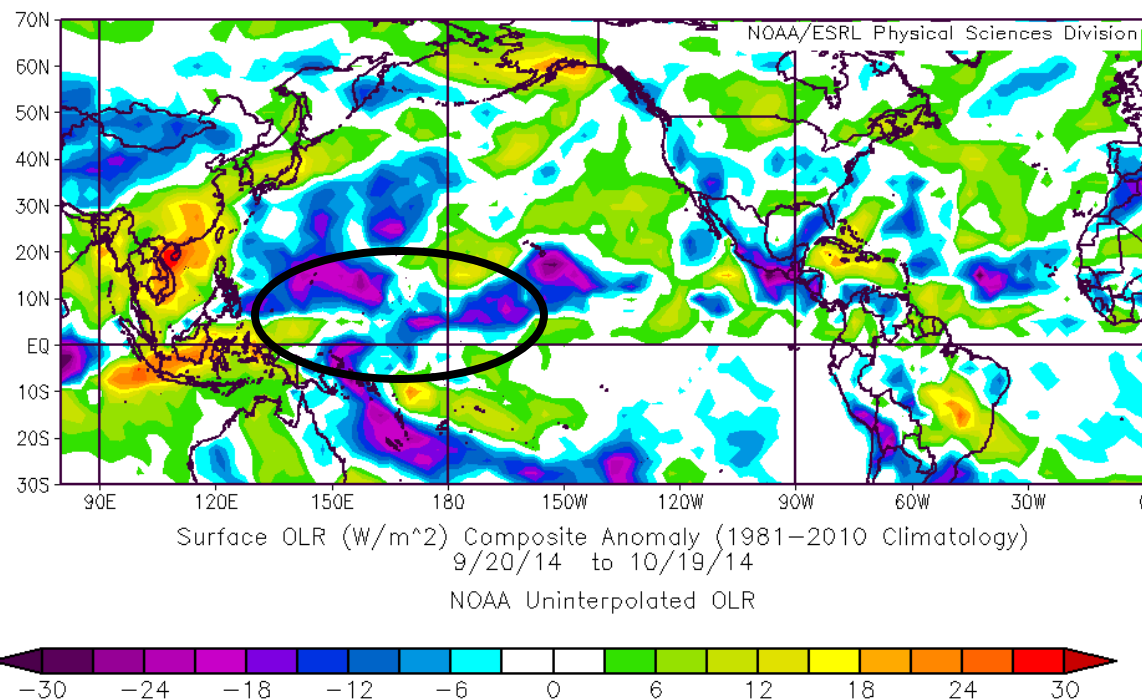
# Current Conditions

## Tropical Thunderstorm Activity

As of late October 2014, tropical convection remains primarily focused over the western Pacific. It has shown some eastward expansion just north of the equator, but is not particularly organized.

Its evolution over the course of winter will be important and will potentially be influenced by the development of a weak el Nino .

### Outgoing Longwave Radiation Anomaly



# Current Conditions

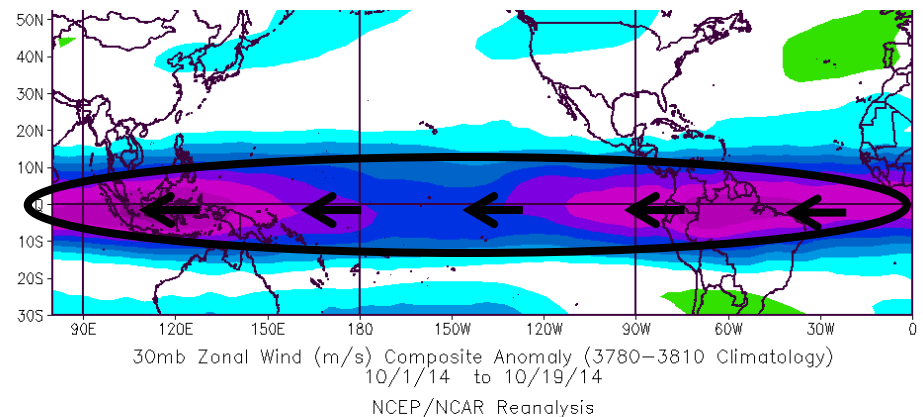
## Strengthening easterlies in the tropical stratosphere

Easterly winds are currently downwelling from the upper stratosphere (top) to the lower stratosphere (bottom). This highly predictable phenomenon can have important implications for seasonal weather.

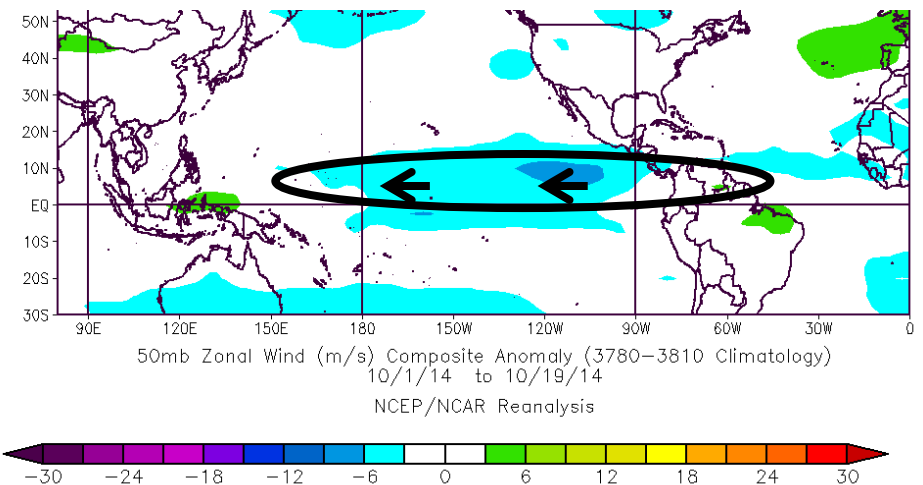
Per [Baldwin et al. \(2001\)](#), the easterly phase (right), is significant because it allows more atmospheric energy to be directed poleward. The resulting convergence of waves results in a deceleration of the polar jet, thereby offering a contribution toward a weaker polar vortex.

For this reason, these easterly winds have physical ties to southward displacements of the polar jet (i.e. [-NAO](#)), which favors colder weather over the eastern U.S., including the Great Lakes.

**Zonal Wind Anomaly at 30mb**



**Zonal Wind Anomaly at 50mb**



# Current Conditions

## High-Latitude Snow Cover

Hemispheric snow cover is a key factor in manufacturing cold airmasses that will eventually impact Southeast Michigan. It is worth taking note of snow coverage prior to the onset of winter. Currently, snow extent is slightly above normal.

In addition, recently published research by [Cohen et al. \(2014\)](#) describes a tie between the pressure patterns caused by vast Autumnal snow cover in Siberia and the resultant strengthening of the jet stream. The strengthening jet causes increased upward energy flux into the polar stratosphere which can help to weaken the polar vortex.

This is yet another factor that may help tip the scales toward a southward displacement of the polar jet and result in periods of colder-than-normal weather in SE Michigan.

**Northern Hemisphere Snow Cover**

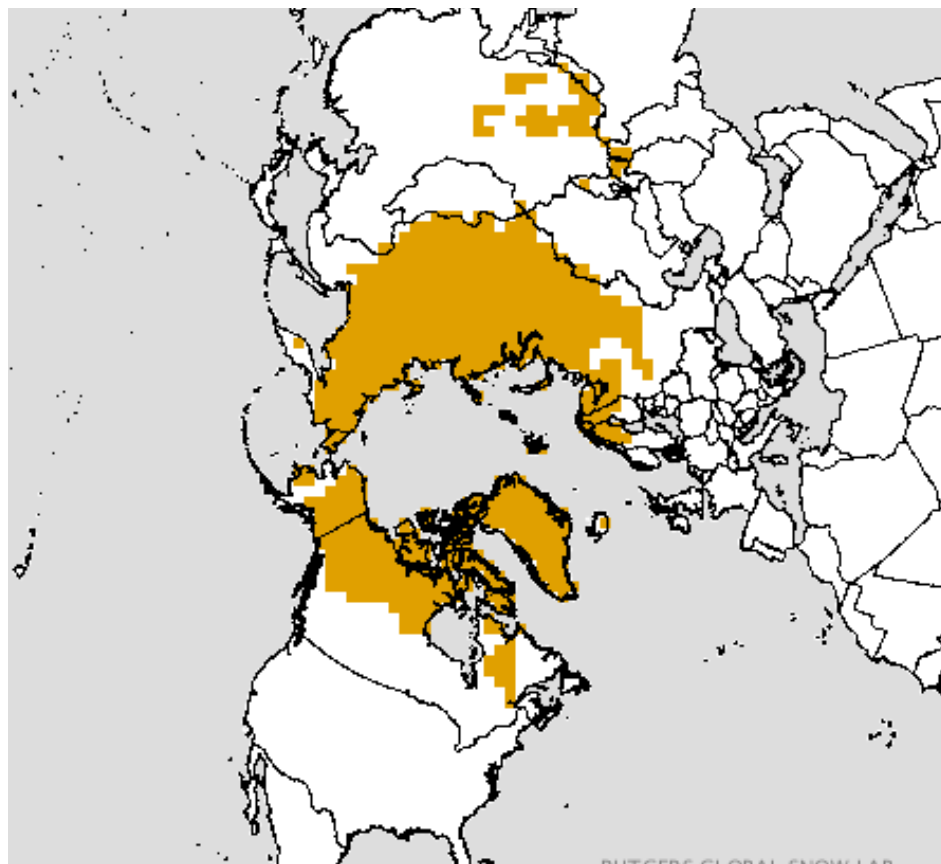


Image courtesy of Rutgers University [Global Snow Lab](#)

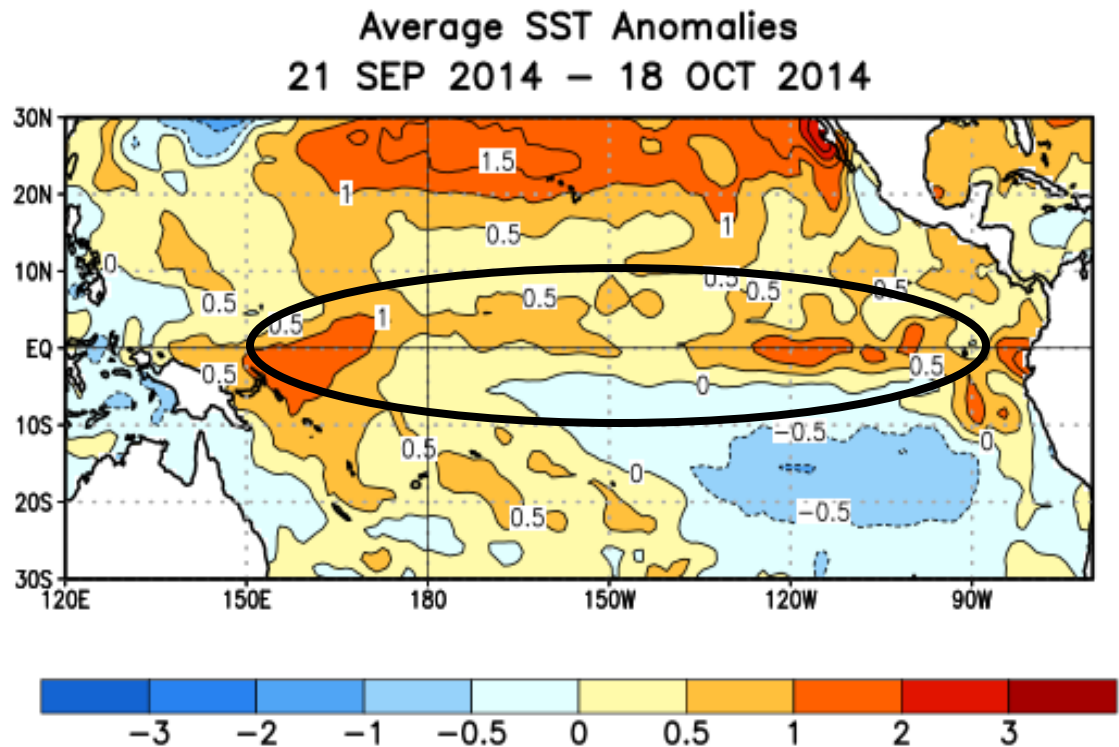


# ENSO Outlook

## Changes to expect

Current sea surface temperature (SST) anomalies are positive across the Equatorial Pacific. This is an important feature to note, because warm SSTs are supportive of enhanced tropical convection which, as noted earlier, can have significant effects on our weather in the mid-latitudes.

There appears to be support for tropical convection to continue to migrate eastward with time due to continued emergence of warm SST anomalies.

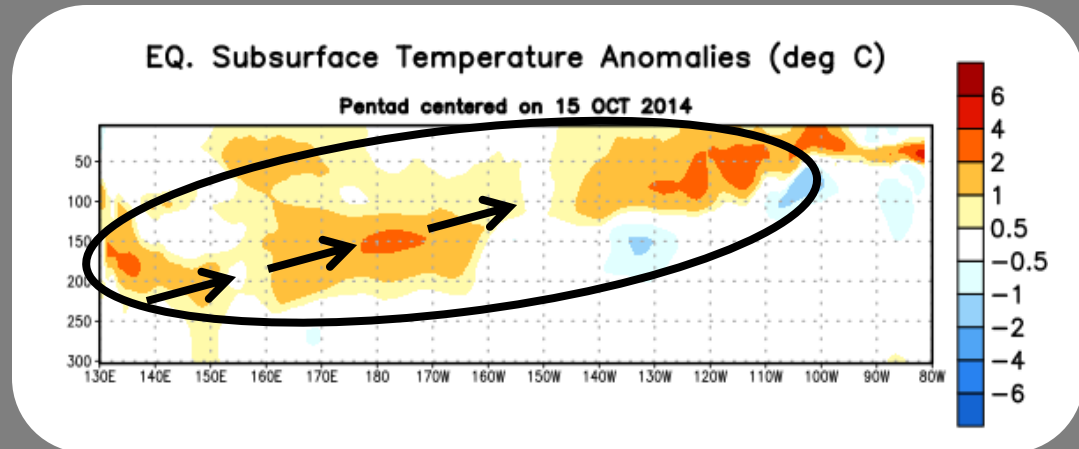


# ENSO Outlook

## Changes to expect

Subsurface temperature anomalies indicate continued support for the existing warm sea surface temperature anomalies. This increases confidence that warm SSTs will persist and potentially have an influence during the cold season.

Any el Nino like effects have been minimal thus far as indicated by the weakly positive [MEI](#) value of 0.500. Recent [forecasts](#) suggest that this should change, however. And, as noted on the next slide, positive-neutral and weak el Nino conditions also tend to favor colder northwest flow in Southeast Michigan.



# Similar Past Years

## Positive-Neutral or Weak el Ninos

At right is a composite of years featuring similar positive-neutral or weak el Nino conditions. This composite is NOT an explicit forecast. However, it does indicate that tropical forcing similar to that expected this year is historically favorable for frequent ridging to develop over Greenland, higher-than-normal heights across the polar regions, and a jet stream displaced to the south across United States and Atlantic Ocean.

This represents a third (stratospheric easterlies, extensive Siberian snowcover) factor that is expected to be in place this winter that will favor a weak polar vortex.

A weak polar vortex is favorable for high amplitude patterns and, this year, it appears that troughing will present more often than not over the Great Lakes.

### 500mb Composite Anomaly

